OCTAHEDRAL PUZZLE APPARATUS

Background of the Invention

Field of the Invention

The present invention relates to mechanical puzzles and more particularly to a manipulable octahedrally shaped puzzle.

Prior Art

Mechanical puzzles have been around for many, many years. They have delighted generations of individuals who enjoy manipulation of clever mechanisms which are designed to present an intellectual challenge to its user. The most notable of these is a cube shaped puzzle known as "Rubiks Cube" or "Magic Cube". It has been an international favorite for decades.

Another puzzle concept is shown in U.S. Patent 4,451,039 to Hewlett, Jr. This mechanical puzzle design is the shape of a regular octahedron. This puzzle design consists of a plurality of tetrahedra and octahedra which are retained as a unit and which permits the faces of the puzzle to be changed by their rotation about an axis perpendicular to their particular plane. This particular arrangement however, relies only upon one spherical boundary

within the plurality of layered components of this puzzle, to hold the pieces together. This single spherical "underlayer" in between the core and its outer layer means that the puzzle as designed, is more susceptible to damage and its parts are less robust than they should be. Such pieces may break or the puzzle itself may fall apart.

It is the object of the present invention to provide an octahedral mechanical puzzle which overcomes the disadvantages of the prior art.

It is a further object of the present invention to provide an octahedral mechanical puzzle with an improved inter-linkage arrangement between the layers of the components so as to permit the present puzzle invention to work more efficiently with improved life.

It is still yet a further object of the present invention to provide an octahedral mechanical puzzle whose components are more robust, more resilient when those components are assembled and which will provide better security and resistance to breakage.

Brief Summary of the invention

The present invention comprises a mechanical puzzle arrangement which is in the shape of a regular octahedron. This mechanical puzzle has a plurality of subcomponents the exterior of which each defines an equilateral triangle each of which may be divided into a plurality of planes perpendicular to the respective equilateral triangle. Those faces of the components of each plane comprise nine smaller equilateral triangles which are the faces of the components consisting of octahedra and tetrahedra.

The puzzle of the present invention comprises a plurality of radially secured components attached to an inner core. The preferred embodiment of the inner core generally comprises a generally octahedral shape having each of its eight triangularly shaped faces having a hub/bore thereon. Each hub is arranged to receive an axis pin about which radially outwardly successive pieces will rotate. The inner core member in a further embodiment may be reduced to an 8 armed "spider", the ends of the arms corresponding to the hubs/bores on the surface to the core octahedral as presently described in the preferred embodiment. In this alternative embodiment, the core tetrahedral members may also be reduced to rotatable pins with triangular curvilinear caps for retaining further parts. Thus in this further embodiment, an 8-armed

“spider” with rotatable arms would have generally triangularly-shaped retaining caps thereon. Returning to the preferred embodiment, a flattened tetrahedral member of generally triangular configuration has a bore extending therethrough. The first tetrahedral member is rotatably attached to the hub of the octahedral core member. The flattened tetrahedral member has a curvilinear radially outermost surface and three curvilinear retaining edges. The curvilinear retaining edges are parallel with their respective edges of the curvilinear base of the tetrahedral member. A flattened tetrahedral member is disposable radially outwardly on each triangular face of the core octahedral member. The bore through each tetrahedral member is in co-axial alignment with the bores through the hubs on the face of each triangular surface of the core octahedral member. Thus there is defined for rotation four axes passing through the core octahedral member.

The arrangement also includes a generally octahedral outer member having two triangular outer faces and four side faces with curvilinear lowermost edges and a central core attached to an elongated curved foot. This part may otherwise be described as an octahedron with four circular or arcuate slices removed from their inner surfaces. That curved foot has a curvilinear outermost surface thereon defining a pair of curved edges. The

curved foot is arranged to slidably engage radially under the curvilinear retaining edges of the flattened tetrahedral members. The arrangement includes a tetrahedral outer member having one triangular outer face, and having a curvilinear trapezoidal foot of trapezoidal configuration. The trapezoidal foot comprises a base portion of the tetrahedral member and is offset with respect to the triangular side portion thereof. The trapezoidal foot of the tetrahedral outer member has non-parallel sides which slidably mate radially under the outermost curvilinear retaining edges of the octahedral member having two triangular outer faces.

The puzzle arrangement includes an octahedral vertex member that is arranged to be disposed at each vertex of the octahedron puzzle. The octahedral vertex member has four triangular face portions and four side trapezoidal faces. The trapezoidal faces are unitary with a generally square shaped foot having a curvilinear upper surface. The square shaped curvilinear foot has curvilinear edges which also slide radially under the outermost retaining edges of the octahedral outer member with two triangular outer faces and under the retaining edges of the outer tetrahedral members with one triangular face, as any part of the face of the octahedron

puzzle is rotated about its respective rotational axis going through its respective hub/bore at the core octahedral member.

The flattened tetrahedral member rotates on each respective face and hub of the core octahedral member about a connecting pin or axis extending into the hub/bore thereadjacent. The octahedral outer member with two triangular faces has its curvilinear edge of its respective foot slide under the respective curvilinear retaining edges of the flattened tetrahedral member. The tetrahedral outer member mates along side the octahedral outer member so that its foot engages under the outmost retaining edge of octahedral outer member. The tetrahedral outer member is mated adjacent each side of the octahedral vertex member so that each respective curvilinear foot is adjacent to one another.

In the assembly of the octahedral puzzle, two spherical boundaries as defined by the collective radially spaced apart curvilinear retaining edges of the flattened tetrahedral curvilinear member and the respective radially outwardly adjacent curvilinear edges of the octhedral outer members and its associated radially outer components to define those two spherical

boundaries to provide a superior locking relationship and slidability there between of their respective components.

The invention thus comprises an octahedron puzzle arrangement comprised of a plurality of radially interlocking components, for permitting rotation of a plane of such components about an axis perpendicular to the plane of components to define a changeable collective face of the puzzle arrangement. The puzzle comprises an inner core octahedral member, a first radially innermost transitional layer of the components, and a second layer of the components, each component of the second layer having at least one face of triangular shape, wherein a planar portion of the components may be rotated about an axis perpendicular to the planar portion of components to effect the change in the collective face of the octahedron puzzle arrangement.

The second layer of the components are arranged in an overlapping array with respect to the innermost transitional layer of the components. A plane of the second layer of components are rotatable with respect to an adjacent plane of components in the second layer. The puzzle in one preferred embodiment has an innermost core octahedral member having

eight triangular faces thereon, each of the faces having an axis bearing bore therein. Each of the faces of the innermost core octahedral member has a flattened tetrahedral member rotatably secured thereon, each flattened tetrahedral member has a curvilinear edge for slidable retention of a further component thereunder. The puzzle includes an octahedral outer member with two triangular faces and with a curvilinear foot portion for engagement with the curvilinear edge of the flattened tetrahedral member. The puzzle includes a tetrahedral member having a curvilinear foot for placement adjacent a further outer component of the puzzle. The puzzle includes an octahedral vertex member having a curvilinear foot for placement at a corner of the collective faces of the puzzle arrangement. The flattened tetrahedral member comprises the first transitional layer rotatable about the inner core octahedral member. The octahedral member, the outer tetrahedral member and the octahedral vertex member comprise the second layer of components.

The invention also comprises a mechanical octahedron puzzle arrangement comprised of a plurality of radially interlocking components, for permitting rotation of a plane of such components about an axis perpendicular to the plane of the components, to define a changeable collective face of the puzzle arrangement, comprising: an inner core

member; a first radially innermost transitional layer of the components secured to the inner core member; and a second radially outer layer of the components, each of the components having an outer face to collectively define a plane of the puzzle arrangement, wherein a portion of the second layer of components may be rotated about an axis perpendicular to the plane of the puzzle arrangement, to effect the change in said collective face of the octahedron puzzle arrangement. The second layer of the components may be arranged in an overlapping array with respect to the innermost transitional layer of the components. The inner core member may comprise an arrangement of intersecting hubs, each of the hubs defining a bore therethrough, about which bore the components will rotate. A pair of hubs are preferably opposed to one another and define an axis through the inner core member. The inner transitional layer of components preferably have a smaller component engaging radius than the outer layer of components.

In the present invention, the inner core tetrahedral components engage only the outer edge octahedral components. These in turn engage the radially adjacent outer tetrahedral and vertex components, as opposed to the prior art Hewlett, Jr. reference 4,451,039, wherein the inner core tetrahedral tetrahedral components engage all of the radially outer components. In the

present invention it is this separation of functionality and consequent second radially-spaced transition layer that provides the present invention with a more robust design both in its individual components themselves and the interconnection mechanisms between those components.

The invention may further comprise an octahedral puzzle arrangement comprised of a plurality of radially interlocking tetrahedral and octahedral components for permitting rotation of a plane of such components about an axis perpendicular to said plane of components, comprising: an inner core octohedral member having eight faces; an inner core of tetrahedral members each rotationally attached to one of said faces of said octahedral core member; a second radially outwardly disposed layer consisting of octahedral components having portions extending radially inward of and under and captured by the inner core of tetrahedral members, the tetrahedral members each having two faces displayed on a surface of the octahedral puzzle; and a third radially outwardly disposed layer consisting of tetrahedral and octahedral members, each of the members of the third layer having at least one face displayed on the surface of the octahedral puzzle. The third layer of tetrahedral and octahedral members preferably have a portion extending radially inwardly to be captured by a portion of the components comprising

the second layer without interfering with the core tetrahedral members. The inner core octahedral member has a means for attaching a core tetrahedral component on each of the faces thereon. The core tetrahedral members may have a triangular cap for radial securement and rotational freedom of adjacent edge octahedral members. The edge octahedral members are radially secured and are permitted rotational freedom by the core tetrahedral members. The edge octahedral members each have an undercut portion spaced radially outwardly from the core tetrahedral members for radial securement of an adjacent surface tetrahedral and a surface octahedral. The surface tetrahedral are radially secured to the puzzle arrangement by an arrangement of feet thereon extending radially inwardly of the edge octahedral. A vertex octahedral member is preferably radially secured to the puzzle arrangement by an arrangement of feet thereon extending radially inwardly of the surface tetrahedral and the surface octahedral members. The inner core octahedral member may be an eight armed spider member. core tetrahedral members each may consist of an extension to an arm of the eight armed spider member.

Brief Description of the Drawings

The objects and advantages of the present invention will become more apparent when viewed in conjunction with the following drawings in which:

Figure 1 is a perspective view of an octahedral puzzle arrangement constructed according to the principles of the present invention;

Figure 2 is a perspective view of a core octahedral member component of the present invention;

Figure 3 is a perspective view of a flattened tetrahedral curvilinear member component of the present invention;

Figure 4 is a perspective view of an octahedral outer edge member component of the present invention;

Figure 5 is a perspective view of a tetrahedral outer member component of the present invention;

Figure 6 is a perspective view of an octahedral vertex member component of the present invention;

Figure 7 is a perspective view of the core octahedral member component with a flattened tetrahedral curvilinear member placed on one face thereof;

Figure 8 is a view similar to that of Figure 7 showing an octahedral outer edge member component having an edge thereof mating with a curvilinear edge of the flattened tetrahedral curvilinear member component;

Figure 9 is a perspective view of the an octahedral outer edge member component being mated with a tetrahedral outer member component showing their respective adjacent curvilinear edges;

Figure 10 is a perspective view of an octahedral vertex member component having a tetrahedral outer member component mounted thereadjacent, showing their respective curvilinear foot members in an adjacent relationship;

Figure 11 is a perspective view of the octahedral puzzle arrangement apparatus with a single layer of components removed;

Figure 12 is a perspective view similar to Figure 11 with a second layer removed;

Figure 13 is a perspective view of the inner core member characterized as an eight armed spider;

Figure 14 is a perspective view of the inner core member spider shown in figure 13, with a radially adjacent tetrahedral member thereattached.

Detailed Description of the Preferred Embodiment

Referring now to the drawings in detail, and particularly to figure 1, there is shown the present invention which comprises a mechanical puzzle arrangement 20 which is in the shape of a regular octahedron. This mechanical puzzle arrangement 20 has a plurality of subcomponents, the planar exterior of each side defines an equilateral triangle 22 each of which may be divided into a plurality of planes perpendicular to the respective equilateral triangle 22. Those faces of the components of each plane comprise nine smaller equilateral triangles 24 which are the faces of the components consisting of octahedra and tetrahedra.

The puzzle of the present invention comprises a plurality of radially secured components attached to an inner core 26, as shown in figure 2. The inner core 26 may comprise a center such as for example, an octahedron having each of its eight triangularly shaped faces 28 having a hub/bore 30 thereon, (or alternatively, a "spider-like" set of arms, see figures 13 and 14, comprising those hubs/bores 30, wherein each opposed pair of hubs/bores 30 defining an axis of the puzzle arrangement 20. Each of the eight hub/bores 30 are arranged to receive an axis pin (not shown for clarity) about which radially outwardly successive pieces will rotate. A flattened tetrahedral

member 32 of generally triangular configuration, as shown in figure 3, has a bore 34 extending therethrough. The first tetrahedral member 32 is rotatably attached to the hub/bore 30 of the octahedral core member 26, as represented in figure 7. The flattened tetrahedral member 32 has a curvilinear radially outermost surface 36 and three curvilinear retaining edges 38. The curvilinear retaining edges 38 are parallel with their respective edges 40 of the curvilinear base 42 of the flattened tetrahedral member 32, as shown best in figure 3. A flattened tetrahedral member 26 is disposable radially outwardly on each triangular face 28 of the core octahedral member 26, by a pin 44, as shown in figure 7. The bore 34 through each tetrahedral member 32 is in co-axial alignment with the bores through the hubs 30 on the face 28 of each triangular surface of the core octahedral member 26. Thus there is defined for rotation four axes "A" passing through the core octahedral member 26, as represented in figure 2.

The arrangement 20 also includes an octrahedral outer member 46, as shown in figure 4 having two triangular outer surfaces 48 and four side surfaces 50 with curvilinear lowermost edges 52 and a central core 54 attached to an elongated curved foot 56. The curved foot 56 has a curvilinear outermost surface 58 thereon, as shown in figure 4, defining a

pair of curved edges 60. The curved foot 56 is arranged to slidably engage radially under the curvilinear retaining edges 38 of the flattened tetrahedral members 32 when the puzzle arrangement 20 is assembled. The puzzle arrangement 20 includes a component identified as a tetrahedral outer member 62 which has a curvilinear trapezoidal foot 64 of trapezoidal configuration and a triangular face 66 and a trapezoidally shaped side face 68, as represented in figure 5. The trapezoidal foot 64 comprises a base portion of the trapezoidal triangular member 62 and is offset with respect to the triangular face 66 portion thereof. The trapezoidal foot 64 of the tetrahedral outer member 62 has non-parallel sides 70 and 72 each of which slidably mate radially under respectively adjacent outmost curvilinear retaining edges of the octahedral outer edge member 46, as will be represented in figure 9.

The puzzle arrangement 20 includes an octahedral vertex member 80, as shown by itself in figure 6, that is arranged to be disposed at each vertex of the octahedron puzzle 20, as represented in figure 1, 11 and 12. The octahedral vertex member 80 has four triangular face portions 82 and four side trapezoidal faces 84. The trapezoidal faces 84 are unitary with a generally square shaped foot 86 having a curvilinear upper surface 88, as

shown in figures 6 and 10. The square shaped curvilinear foot 86 has curvilinear edges 90 which also slide radially under the outermost retaining edges 52 of the octahedral outer edge member 32 as any part of the face 22 of the octahedron puzzle 20 is rotated about its respective rotational axis "A" going through its respective hub/bore 30 at the core octahedral member 26.

The flattened tetrahedral member 32 rotates on each respective face 28 and hub/bore 30 of the core octahedral member 26 about a connecting pin or axis 44 extending into the hub/bore 30 thereadjacent. The octahedral outer edge member 46 has its curvilinear edge 60 of its respective foot 56 slide under the respective curvilinear retaining edges 38 of the flattened tetrahedral member 32. The tetrahedral outer member 62 mates along side the octahedral outer edge member 46, as represented in figure 9, so that its foot 64 engages under the outmost retaining edge 52 of the octahedral outer edge member 46. The tetrahedral outer member 62 is mated adjacent each side of the octahedral vertex member 80, as represented in figure 10, so that each respective curvilinear foot 64 and 90 are adjacent to one another.

An alternative embodiment of the inner core member is shown in figure 13, depicting an eight armed "spider" core member 92 with its

hubs/bores 30 arranged to rotationally support radially adjacent members. Such a radially adjacent tetrahedral member 94 is shown attached to one of the hubs/bores 30, as represented in figure 14

In the assembly of the octahedral puzzle 20, two spherical boundaries as defined by the collective radially spaced apart curvilinear retaining edges 38 of the flattened tetrahedral curvilinear member 32 and the respective radially outwardly adjacent curvilinear edges 52 of the octahedral outer edge members 46 and its associated radially outer components to define those two spherical boundaries to provide a superior locking relationship and slidability there between of their respective components.

The puzzle arrangement 20 may be moved by rotation "R" or "R' ", (as represented in figure 1 for example), of respective planes of components about their respective axis "A" perpendicular thereto. By such rotation of respective planes of components, the outer faces of those components may display varying colors, designs or representations.